### SPRING 2001 FINAL EXAMINATION FOR Statistics & Probability
1330–1630 on Tuesday 8 May 2001

This exam is "open book and open notes" as long as these sources are your own; you may not borrow or share anything (calculator, text, notes, etc.). You are to simplify numerical answers to simple fraction or decimal form. Please show your work. †

1. Use the box-and-whisker plot below left to obtain for the data it represents (Math Placement Exam scores): [a] the range [b] the median [c] Q_1 [d] Q_3 [e] IQR. [f] Is this data skewed left, skewed right, or neither? Explain.
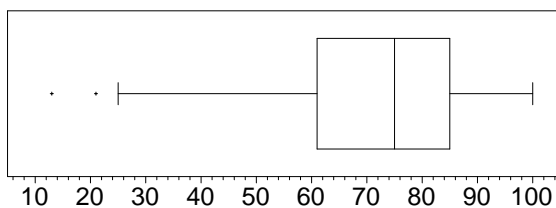
```
3 | 8
4 | 3 6
5 | 0 1 4 5
6 | 3 4 6 7 7 7 8 9
7 | 2 2 3 5 6 8 9
8 | 0 7 8 9
```

2. Use the stem-and-leaf display above right to obtain for that data: [a] the range [b] the median [c] Q_1 [d] Q_3 [e] IQR. [f] Is this data unimodal? Explain.

3. The following data give the weight lost by 15 members of the Bancroft Health Club and Spa at the end of two months after joining the club. Compute for this data: [a] the sample mean and [b] the sample standard deviation.

5	10	8	7	25	12	5	14	11	10	21	9	8	11	18

4. Let X be the number of typographical errors that occur on a randomly selected page of a certain textbook. The following table lists the probabilities associated with X. Use it to compute [a] the population mean and [b] the population standard deviation.

# Errors	0	1	2	3	4
Probability	0.73	0.16	0.06	0.04	0.01

5. According to a _USA TODAY_ survey of 20,000 American middle and high school students, 70% admitted to cheating on an exam (_Forbes_, 25 Jan 99). Suppose that this result is true for the current population of all U.S. middle and high school students. [a] What is the probability that in an SRS of 10 such students, 7 or 8 students would admit to cheating on an exam? [b] What is the probability that in an SRS of 100 such students, from 70 to 80 (inclusive) students would admit to cheating on an exam?

6. Assume that the depth X of a single well drilled in a certain area has a normal distribution with mean 290 feet and standard deviation of 40 feet. [a] What is the probability that Company A will drill one well deeper than 310 feet? [b] What is the probability that Company A will drill 10 wells an _average_ of more than 310 feet? Assume that Company A charges $1000 plus $12 per foot to drill a well. Let P be the price of drilling a single well. Compute [c] the mean of P and [d] the standard deviation of P.

---

7. According to a study by the Bureau of Labor Statistics, the mean annual earnings of physicians and surgeons in the U.S. is \$100,920 (*The Wall Street Journal*, 2 Feb 99). Suppose that the current annual earnings of all U.S. physicians and surgeons has a probability distribution with a mean of \$100,920 and a standard deviation of \$22,500. Suppose an SRS of 400 is sampled from the population of U.S. physicians and surgeons. **[a]** Compute the probability the sample mean will be within \$2000 of the population mean. **[b]** Compute the probability that sample mean will fall at least \$1500 below the population mean.

8. According to the U.S. Transportation Department, drivers who run red lights are involved in about 89,000 crashes a year. Researchers at Old Dominion University surveyed licensed drivers and found that 56% of them admitted running red lights (*USA TODAY*, 5 Oct 99). Assume that is result is true for the current population of all licensed drivers in the U.S. Let $\widehat{p}$ be the sample proportion in an SRS of 400 licensed drivers selected from the U.S. who will admit to running red lights. Compute **[a]** the mean of $\widehat{p}$ and **[b]** the standard deviation of $\widehat{p}$. **[c]** Compute/approximate the probability that the value of $\widehat{p}$ exceeds 0.60.

9. According to the IRS, the average deduction taken for medical expenses is \$4160 for taxpayers with adjusted gross incomes between \$20,001 and \$25,000 (*USA TODAY*, 5 Mar 99). Assume that this mean is actually a sample mean based on an SRS of 1000 such taxpayers and that the sample standard deviation is \$1500. Construct a 99% confidence interval for the mean medical deduction taken by all taxpayers with adjusted gross incomes between \$20,001 and \$25,000.

10. The U.S. Bureau of the Census wants to estimate the mean family size of all U.S. families at a 99% confidence level. It is known that the standard deviation σ for the size of a U.S. family is 0.6. Compute the minimum size of an SRS that the Bureau should select in order to obtain an estimate within 0.01 of the population mean.

11. According to data from the House Ways and Means Committee, the average total time required for taxpayers to prepare IRS Schedule A (itemized deductions) was about 4.5 hours (*USA TODAY*, 20 Apr 99). A taxpayers' organization claims that the time required to prepare this form averages more than 4.5 hours. Suppose that an SRS of 26 taxpayers shows a mean preparation time of 4.75 hours with a standard deviation of 0.75 hours. *Question:* Does this data "prove" the taxpayers' organization claim? Assume that the preparation time is nearly normally distributed. **[a]** Write down the appropriate null and alternative hypotheses, **[b]** compute the appropriate test statistic, and **[c]** compute the P-value for this test and data. **[d]** Answer the question and give the probability of falsely rejecting a true null ("no change") hypothesis.

12. According to data from the College Board, the average cost for room and board at public four-year residential colleges for 1997–98 was \$4361 and the corresponding average cost for private colleges was \$5549 (*The Chronicle of Higher Education Almanac*, 28 Aug 98). Suppose that these means were obtained from an SRS of 15 public and an SRS of 14 private four-year residential colleges. Further assume that the sample deviation of such costs were \$1200 for public colleges and \$1540 for private colleges. Further assume that the 1997–98 room and board costs for both groups of colleges are normally distributed with unequal and unknown population standard deviations. **[a]** Construct a 95% confidence interval for the difference between the two population means. **[b]** Does your answer to the preceding part indicate that the two population means are not equal? Explain and be sure to state the probability that you will make a mistake in concluding that the population means are unequal.

13. According to two polls conducted for AARP, 14% of grown children say that they provide some housekeeping help for their elderly parents, whereas only 9% of parents agree with this statement (*USA TODAY*, 28 Jan 99). These estimates are base on SRSs of 1689 grown children and 896 parents for the two polls. *Question:* Should one conclude that the two population proportions are different? **[a]** Write down the appropriate null and alternative hypotheses, **[b]** compute the appropriate test statistic, and **[c]** compute the P-value for this test and data. **[d]** Answer the question and give the probability of falsely rejecting a true null ("no difference") hypothesis.